Biology

Biology Office Location
Science Center, Room 342

Special Entry Requirements
None

Placement Examinations
None

Goals
At the completion of the Bachelor of Science degree in the Department of Biology, a graduate will have acquired an understanding of major biological concepts and an awareness of how these are connected with areas of the biological, physical and social sciences.

Objectives
Biology majors will gain specific knowledge and skills in the following core competencies:

Disciplinary Breadth
1. understand functional categories of biological organization and interconnections among them
2. develop a solid foundation of basic biological concepts that inform scientific understanding
3. understand how evolutionary mechanisms apply in molecular, cellular, organismal and community level dynamics

Scientific Literacy
1. develop skills of observation and critical reading of texts and environments
2. interpret representations of data and models
3. understand hypotheses and conclusions
4. identify gaps in knowledge
5. formulate scientific questions
6. recognize synthesis of new ideas

Communication Skills
1. develop skills to interpret and construct a scientifically based argument
2. develop oral communication skills for formal presentations and informal scientific discourse
3. develop facility with scientific writing and model making

Analyzing Scientific Data and Results
1. interpret quantitative and qualitative representations of data in tabular, graphical or descriptive form
2. identify significant trends in scientific data
3. evaluate scientific results in terms of original hypothesis
4. apply statistical analysis to scientific interpretation

Science as an Experimental Process
1. synthesize scientific hypothesis and derived research questions
2. design hypothesis-driven, controlled experiments
3. construct appropriate data sets
4. critique experimental approaches

Developing Technical Expertise
1. develop proficiency in accurate data collection
2. conduct proper calibration and use of scientific instrumentation
3. develop appropriate use of scientific techniques in experimental design

Science as a Way of Knowing
1. understanding the process of science compared to other modes of inquiry
2. integrating scientific knowledge and biology within a social, political or historical context
3. recognizing both the potential and limitations of scientific application

Integrated Identity
1. exploring intersections of identity as Spelman biology majors
2. reflecting on how academic preparation and professional aspirations impact their worldview
3. Reflect on how their worldview impacts their professional and academic aspirations and their value system

General Core Requirements
None

International/Women's Studies Requirement
Courses that satisfy the International/Women's Studies requirement are listed in the Course Sequence Booklet on the Spelman Web page.

Teacher Certification
See Education Studies Program

Departmental Honors
Biology majors who score in the top 20 percent on the senior comprehensive examination, have an overall grade point average of 3.0 or better with no grade less than "C," and a biology grade point average of 3.25 or better and no repeated courses will graduate with departmental honors. All comprehensive examinations must be taken to qualify for departmental honors.

Departmental Honor Societies
Beta Kappa Chi National Scientific Honor Society and Beta Beta Beta National Biological Honor Society

Major Requirements
A major in biology consists of 42 semester hours of coursework in biology. The course of study for the major in biology (B.S.) is described below:

Required courses

- BIO 110 Biological Communities, Evolution and Biodiversity, (4)
- BIO 115 Organismal Form and Function (4)
- BIO 120 Cellular Biology (4)
- BIO 125 Molecular Biology (4)
- BIO 285 Sophomore Seminar (1)
- BIO 485 Senior Seminar (1)

Elective courses

Students must complete a total of 24 elective credits in biology, including at least one course from each of four organizational levels (Population, Organismal, Cellular and Molecular), and at least one course from each of three skills emphases (Literacy, Experimental, Analytical/technical). Elective courses designated in each of these categories will be published prior to registration each semester.

Elective credits may also be filled by other appropriate courses such as

1. upper level biology courses (300 or higher) at other AUC institutions;
2. up to 4 hours of coursework in other disciplines relevant to biology training (examples might include History of Medicine, Biostatistics, Biomedical Ethics, Epidemiology, etc.);
3. up to 4 hours of elective credit through independent research, BIO 487, with approval of a faculty supervisor and the department chair.

All biology electives taken outside of the biology department or at AUC institutions must receive prior approval from the department chair.

Cognate courses

Biology majors must complete the following cognate courses with a grade of C or better:

Chemistry

- One year of General Chemistry with lab: CHE 111, CHE 111L, CHE 112, CHE 112L
- One year of Organic Chemistry with lab: CHE 231, CHE 233L, CHE 232, CHE 234L

Mathematics

- Two semesters of Mathematics selected from the following: MAT 211, MAT 212, MAT 205

Physics

- One year of General Physics with lab: PHY 111, PHY 112

Computer Science

- One semester of Computer Science for science majors – CIS111 or higher

Course Descriptions

BIO 100 – BIOLOGY OF WOMEN (4)

Perspectives on the distinct biology of women, including evolution and gender, female development and anatomy, endocrine cyclicity, sexual differences in brain and behavior, contraception, sexually transmitted infections, infertility, pregnancy, birth and breastfeeding, menopause, and women's diseases and cancers. Also the roles of science in society and women's empowerment through knowledge of our bodies. Three hours of lecture and one three-hour laboratory per week.

BIO 110 – BIOLOGICAL COMMUNITIES, EVOLUTION, AND BIODIVERSITY (4)

A majors-only introductory course designed to introduce the skills and foundations of biological science. Topics include ecosystem dynamics, natural selection and evolution, phylogeny, and biodiversity. This course emphasizes skills in "reading science." This course is designed for biology majors. Three hours lecture, three hours laboratory per week. Prerequisites: None. Annually, fall semester.

BIO 115 – ORGANISMAL FORM AND FUNCTION (4)

An introduction to basic themes of organismal form and function, including growth, reproduction, transport, and homeostasis. Topics include mechanisms of growth and development, adaptive strategies, physiological regulation, and organismal diversity in plant and animal systems. This course emphasizes skills in "talking science." This course is recommended for students completing biology course prerequisite for medical school. Course meets twice weekly for two and a half hours. Prerequisites: None. Annually, spring semester.

BIO 120 – CELLULAR DYNAMICS (4)

An introduction to cell structure and dynamics including molecular composition, flow of energy and flow of information in cells. Topics include cellular structure and composition, metabolism and bioenergetics, membrane transport, and cell cycle. This course emphasizes skills in "writing science." This course is recommended for students completing biology course prerequisite for medical school. Course meets twice weekly for two and a half hours. Prerequisites: None. Annually, fall semester.

BIO 125 – MOLECULAR BIOLOGY AND GENOMICS (4)

An advanced introductory course for majors that focuses on major developments in the era of genomics. Topics include molecular dynamics and gene expression, phylogenetics and molecular evolution, genomics and bioinformatics. This course emphasizes skills in "doing science." This course is reserved for biology majors. Course meets twice weekly for two and a half hours. Prerequisites: Biology majors are expected to have successfully completed the introductory core sequence of BIO 110, 115, and 120 before enrolling in BIO 125. If this is not the case, the permission of the Instructor is needed for enrollment. Annually, spring semester.

BIO 211 – PLANT BIOLOGY (4)

A study of the basic principles necessary for understanding plant structure and function including the biochemical and biophysical processes of plant cells and the importance of plant life to humans and to other animals. Two one-hour lectures and one three-hour laboratory period per week. Prerequisites: BIO 110, 115, 120, 125. Annually, fall semester.

BIO/ES 225 – ECOLOGY (4)

An in-depth view of ecology through an integrated approach that focuses on the importance of individual species in their respective ecosystems. Central to this approach are six distinct areas which begin with (1) Ecology: its meaning and scope, including experimentation models, (2) The organism and its environment, (3) The ecosystem concept, (4) Comparative ecosystem ecology, (5) Population ecology, and (6) The community. Two one-hour lectures and one three-hour laboratory period per week. Attendance on field trips required. Prerequisites: BIO 110, 115, 120, 125. Alternate years, spring semester.

BIO 233 – MICROBIOLOGY (4)

A study of the structure, function, metabolism, growth, and genetics of microorganisms that emphasizes the diversity of the microbial world. Three one-hour lectures and two two-hour laboratories per week. Prerequisites: BIO 110, 115, 120, 125. Alternate years, spring semester.

BIO 285 – SOPHOMORE SEMINAR (1)

This full-year course is required for all biology majors in their sophomore year. Weekly meetings include full group meetings and break out sessions

that provide forums for students to learn about contemporary research developments, explore professional and career options, and build community with advanced biology majors. Annually, fall and spring semesters.

BIO 312 – GENETICS (4)
A study of the fundamental principles of genetics that examines the molecular mechanisms operative in prokaryotic and eukaryotic cellular systems and the genetic diversity of plants and animals. Emphasis on recombinant DNA technologies. Course meets twice weekly for two and a half hours. Prerequisites: BIO 110, 115, 120, 125. Annually, fall semester.

BIO 313 – FROM MENDEL AND BEYOND (4)
Studies of the genetic basis of cellular and organismal phenomena. Topic coverage begins with Mendelian patterns of inheritance and moves through non-mendelian genetic analyses and discussion. These new analytical tools are then used to explore the genetics of autism, lupus, heart disease, breast cancer and mental illness.

BIO 314 – ENVIRONMENTAL BIOLOGY (4)
A presentation of the diverse issues related to the environment from (1) a humanistic view that involves a holistic look at major environmental issues, and (2) a direct evaluation of the environment by analytical applications. A study of the mechanisms of ecosystems, demographics, food production, natural resources, air and water quality, waste disposal and management and current topics such as in situ bioremediations of pollutants using simulated microbial systems. Prerequisites: BIO 110, 115, 120, 125. Alternate years, fall semester.

BIO 320 – MOLECULAR GENOMICS AND PROTEOMICS (4)
Concepts and software related to mining databases of nucleic acids and proteins, including methods for gene identification, protein structure prediction, and methods of comparative genomics and proteomics. Applications related to the use of microarrays, metabolic pathways and molecular phylogenetic relationships will also be presented. Prerequisites: BIO 110, 115, 120, 125. Annually, fall semester.

BIO 325 – EVOLUTION IN ACTION (4)
The study of evolution is one that is central to an understanding of biology and health sciences. This course will explore the importance of concepts in evolutionary biology to human welfare through selected case studies. Students will gain an understanding of the relevance of evolutionary biology in medicine, industry, agriculture, and environmental sciences. Three one-hour lectures per week. Prerequisites: BIO 110, 115, 120, 125. Alternate years, spring semester.

BIO 326 – BIOLOGY IN CONTEXT (2)
A seminar course that provides an opportunity for students to apply and integrate their knowledge of biology by reading and discussing the secondary science literature.

BIO 328 – IMMUNOLOGY (4)
A study of the immune system with an emphasis on mechanisms by which the immune system protects against disease; mechanisms underlying diseases caused by deficiencies or malfunctions of the immune system; and basic technologies used in immunology. Prerequisites: BIO 110, 115, 120, 125. Alternate years, spring semester.

BIO 329 – NUTRITION IN CANCER (2)
Nutrition in Cancer is an integrated biology course for majors. The purpose of this course is to discuss the role of food-derived agents on risk of developing cancer. In this studen-driven class we will 1) familiarize students with effects of obesity (or energy imbalance), macro- and micronutrients on cancer development and progression; 2) explore the role nutrition plays in disease therapy; and 3) apply our knowledge and critical thinking skills to evaluate controversies around nutrition and cancer.

BIO 330 – PARASITOLOGY (2)
An in-depth examination of the biology and ecology of parasitic protozoa and helminths, the causative agents of major health problems in people and domestic and wild animals world-wide. Parasitic life-cycles, host-parasite interactions, immune response, and strategies for prevention and control will be covered. Prerequisites: BIO 110, 115, 120, 125. Alternate years, spring semester.

BIO 332 – SCIENTIFIC COMMUNICATION (2)
This course is designed to develop and improve both written and oral communication skills, especially as related to science. The course consists of extensive analysis and critical evaluation of current primary literature to compose a "mini" review article that addresses a specific topic. The analysis should reveal knowledge gaps that will be used to design a potential research project and mock grant proposal. The course will help students understand and interpret scientific data, recognize the interrelatedness of multiple studies within a larger framework, and question the validity and reliability of published data. The course consists of lectures, student presentations and constructive critiques that take place throughout the semester. Prerequisites: BIO 125 or equivalent.

BIO 356 – DEVELOPMENTAL BIOLOGY (4)
An introductory study of the fundamental principles of embryological development with emphasis on the higher vertebrates. A detailed study of gametogenesis, cleavage patterns and basic body plans, and organ system formation. Three one-hour lectures and one three-hour laboratory per week. Prerequisites: BIO 110, 115, 120, 125. Annually, spring semester.

BIO 360 – ANIMAL BEHAVIOR (4)
An advanced course that examines the relationship between hormones and behavior using a multi-disciplinary, comparative approach. Topics include hormonal regulation of social behaviors such as male/female reproduction, courtship, pair bonding, and parental care. This course is writing intensive. Prerequisites: BIO 110, 115, 120, 125. Annually, fall semester.

BIO 372 – NEUROBIOLOGY (4)
A study of the fundamental organization and principles of the nervous system. An examination of the ionic mechanisms of the membrane potential, synaptic transmission, and the cellular organization of the nervous system including general sensory systems, special senses, motor system, and autonomic nervous system. Memory, learning, and behavior are also considered. Three one-hour lectures and one three-hour laboratory per week. Prerequisites: BIO 110, 115, 120, 125. Alternate years, fall semester.

BIO 380 – CRITICAL ANALYSIS IN BIOLOGY (4)
This course provides an opportunity for students to apply and integrate their knowledge of biology by reading and discussing the primary science literature. Also, students will approach critical thinking and analysis as a formal skill to be learned and developed. The substrate on which they will learn and practice their analytic skills will be papers drawn from the primary research literature. Additionally, students will complete a semester long individual project using online datasets to develop and test a hypothesis. Opportunities will be given for students to present their analyses in written, oral, and poster formats.

BIO 386 – GENOMICS, PROTEOMICS, AND BIOINFORMATICS (4)
The course is designed to be research-intensive and student-centered. It aims to teach them the hypothesis-driven research paradigm, conduct independent research projects in the exciting fields of genomics, proteomics, and computational biology, and how to write scientific manuscripts. Students will learn to test their hypotheses by statistical analysis of genomic data, computational modeling and simulation, and comparative genomics. This course will offer hands-on learning experiences of the state-of-the-art computing and bioinformatics technology. Students will learn the basic programming skills and statistical methods using R to address questions in genomics research. Topics include regression analysis, statistical tests, permutation test, phylogenetic analysis, detection of selection at the molecular levels, comparative genome analysis, gene expression analysis, gene/protein interaction network and pathway analysis.

BIO 394 HONORS INDEPENDENT STUDY IN BIOLOGY (3-4)
Faculty-guided student research on a problem of current interest, emphasizing and demonstrating the scientific method. Application of the concepts and techniques developed in lecture and laboratory courses to current scientific problems. Prerequisites: BIO 110, 115, 120, 125. Required: Submission of an honors thesis to the Biology department upon completion. Mandatory for biology majors in the Honors Program.

BIO 470 – BIOMOLECULES (4)
A condensed, focused biochemistry lecture course that emphasizes biological relevance of structure and biological chemistry of proteins, lipids, carbohydrates, and nucleic acids; enzyme kinetics and mechanisms; membrane structure and function; bioenergetics; intermediary metabolism and regulation of cellular processes. Prerequisites: BIO 110, 115, 120, 125; CHEM 231-232. Annually, spring semester.

BIO 471 – CELLULAR AND MOLECULAR BIOLOGY (4)
A lecture course which seeks to develop an understanding of the cell at the molecular level. Cellular anatomy and physiology, cellular ultrastructure, molecular genetics, control of transcription, DNA replication and cell cycle, signal transduction, the cellular basis of development, and the laboratory methods of cell and molecular biology. Prerequisites: BIO 110, 115, 120, 125, and at least one upper-level (200 or higher) biology course. Annually.

BIO 472 – MAMMALIAN PHYSIOLOGY (4)
A systems physiology lecture course of the physical, chemical, and biophysical processes that compose and regulate the activities of living cells. Emphasis on the manner in which individual cells and organs are integrated into the complex functions of the living body. Prerequisites: BIO 110, 115, 120, 125. Annually.

BIO 475 – METHODS IN MODERN BIOLOGY (4)
An intensive laboratory-based course designed for senior Biology majors to familiarize students with some of the biochemical and molecular biological techniques that are standard practice in most research laboratories. The students will (1) acquire biochemical and molecular technical skills, (2) gain insight into the biophysical foundations of these techniques, (3) be exposed to the growing field of bioinformatics and how computers are used in this field, and (4) enhance their verbal and written communication skills. Prerequisites: BIO 110, 115, 120, 125.

BIO 485 – BIOLOGY SEMINAR (1)
This full-year capstone course is required for all biology majors in their senior year. Weekly meetings include forums for majors to pursue selected research topics in depth, develop scientific communication skills, and build a peer network with sophomore biology majors. Graduating seniors must prepare a seminar on their selected research topic and deliver a public presentation to an audience of biology students and faculty. Annually, fall and spring semesters.

BIO 486 – MOLECULAR MECHANISMS OF SIGNAL TRANSDUCTION (2)
Covers fundamental concepts in cellular signaling by exploring mechanisms by which cells receive and respond to external stimuli. Journal club format. Prerequisites: BIO 110, 115, 120, 125, 471.

BIO 487 – UNDERGRADUATE RESEARCH (2-4)
Faculty-guided student research on a problem of current interest, emphasizing and demonstrating the scientific method. Application of the concepts and techniques developed in lecture and laboratory courses to current scientific problems. Prerequisites: BIO 110, 115, 120, 125. Required: Submission of a proposal before work commences and a research paper upon its completion. Open to juniors and seniors by permission, and mandatory for Honors Program students.

BIO 491 – SELECTED TOPICS IN BIOLOGY (2-4)
An in-depth study of selected topics in biology. Focused, detailed discussions of research literature and current research problems including parasitology, tumor biology, molecular biology, hypertension, environmental microbiology, salt and water balance, cellular mobility, hormone synthesis and secretion, and cellular regulation. Prerequisites: BIO 110, 115, 120, 125. Annually.